BUILDING COMMISSIONING

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MAXIMIZE RETURN ON INVESTMENT

Modern Building Physical & Mechanical Plants

- Today's complex and integrated building systems have necessitated independent verification of systems installation and operational integration.

Commissioning

- ***Commissioning*** will ensure that all structural & mechanical systems have been installed properly, functionally tested, and are in conformity with the design intent.

What is Building Commissioning?

- Building commissioning is a systematic and documented process of ensuring that the owner's operational needs are met, building systems perform efficiently, and building operators are properly trained.

What is the Goal of Building Commissioning?

- To deliver a facility that operates as it was intended.
- To provide a facility that meets the needs of the building owner and occupants.
- To provide appropriate training for facility operators on the operation and maintenance of the building systems.

When Should the Building Commissioning Process Begin?

- Building commissioning can be started near the end of construction. (GOOD)
- Building commissioning can be started at the start of construction. (BETTER)
- Building commissioning can be started during schematic design. **(BEST)**

Why Start Building Commissioning Process Early?

- Benefits of early involvement – Design review, better building commissioning specifications, clear building commissioning expectations, and better bids.

- Early involvement by the commissioning agent may not carry a cost premium. It will reduce project design problems and will introduce building commissioning expectations early.

Develop a Building Commissioning Scope of Work

- Before meeting with the commissioning agent develop a draft commissioning scope of work.
- Ask the facility owner and operator what were the problems they have encountered on previous construction projects.
- Do not limit your commissioning to just HVAC and controls. Envelope, and other complex systems should be considered.

Develop a Building Commissioning Scope of Work

- Then use the Commissioning Guidelines for systems to be commissioned.
  - HVAC systems
  - Air distribution systems
  - Plumbing and piping systems
  - Heating and cooling plant equipment
  - Control systems
  - Electrical systems

Chiller Commissioning

Chiller Documentation Checks

Documentation complete as per contract documents

√ YES

Check	CH-01	CH-02
Equipment manufacturer's submittals, inc. performance	√	√
Installation and start up manual	√	√
Start up documentation	√	√
Test and balance report	√	√
Sequences and control strategies	√	√
O&M manuals	√	√

Chiller Equipment Data Checks

Criteria for Acceptance: ***In accordance with submittals as approved by Engineering.***			
DESCRIPTION	***CH-01***		
	As specified	*As submitted*	*As installed*
Manufacturer **TRANE**	**YES**	**YES**	**YES**
Model # **CVH-555**	**YES**	**YES**	**YES**
Serial # **L03E05016**	**N/A**	**N/A**	**YES**
Chiller Type **Centrifugal**	**YES**	**YES**	**YES**
Condenser Type **Water**	**YES**	**YES**	**YES**
Compressor Motor, volts	**YES**	**YES**	**YES**
Compressor Motor, LRA	**YES**	**YES**	**YES**
Compressor Motor, FLA or RLA	**YES**	**YES**	**YES**
Refrigerant Type	**YES**	**YES**	**YES**
Manufacturer's Efficiency Rating, kW/ton @ ARI standard conditions (catalog rating)	**YES**	**YES**	**YES**

Chiller Installed Characteristics Checks

Check Equip Tag->	**CH-01**	**CH-02**
Factory start-up sheet completed and attached. (For new construction, this sheet must be completed before proceeding.)	**YES**	**YES**
Test and balance report reviewed for chiller system flows	**YES**	**YES**
Chiller and accessory environment clean	**YES**	**YES**
Adequate chiller & accessory access for maintenance	**YES**	**YES**
No visible water or oil leaks	**YES**	**YES**
No unusual noise or vibration	**YES**	**YES**
Chilled water piping insulation in good condition where visible	**YES**	**YES**
P/T plugs installed where specified	**YES**	**YES**
Pressure gauges & thermometers installed where specified	**YES**	**YES**
Chilled water setpoint (panel readout). ***Acceptance:*** *±2 F deg from design*	**YES**	**YES**
Electrical current limit setpoint (panel readout). ***Acceptance:*** *±5% from design*	**YES**	**YES**
Record & explain any diagnostic codes in control panel memory. ***Acceptance:*** *Causes of all serious codes have been corrected.*	**YES**	**YES**
O&M manual on site	**YES**	**YES**

Chiller Controls Sensor Calibration Checks

Sensor Calibration Methods: *Verifying all sensor locations are appropriate and away from causes of erratic operation. Those sensors with shielded cable are grounded only at one end. For sensor pairs used to determine a temperature or pressure difference, making sure they are reading within 0.2°F of each other for temperature and within a tolerance equal to 2% of the reading, of each other.*

- **Criteria for Acceptance:** *Temperature sensors, BMS values ± 2 F degrees from measured values.*

CONTROL TYPE	SENSOR / STAT LOCATION	CONTROL LOCATION OK?	MEASURED VALUE	BMS VALUE	ACCEPTABLE?
Outdoor air temp., global (EMS) **85.9 F**	**At N/S roof**	**Yes**	**85.9 F**	**85.9 F**	**Yes**
Chiller- CH-01					
Evap. water temp. in	**At chiller**	**Yes**	**52.5 F**	**52.4 F**	**Yes**
Evap. water temp. out	**At chiller**	**Yes**	**40.5 F**	**41.2 F**	**Yes**
Cond. water temp. in	**At chiller**	**Yes**	**75.1 F**	**75.1 F**	**Yes**
Cond. water temp. out	**At chiller**	**Yes**	**87.3 F**	**88.3 F**	**Yes**
Setpoint temp.	**At chiller**	**Yes**	**40.1 F**	**40.1**	**Yes**
GPM	**At chiller**	**Yes**	**494**	**494**	**Yes**
Chiller- CH-02					
Evap. water temp. in	**At chiller**	**Yes**	**52.6 F**	**51.6 F**	**Yes**
Evap. water temp. out	**At chiller**	**Yes**	**42.8 F**	**42.6 F**	**Yes**
Cond. water temp. in	**At chiller**	**Yes**	**75.1 F**	**75.1 F**	**Yes**
Cond. water temp. out	**At chiller**	**Yes**	**88.3 F**	**88.3 F**	**Yes**
Setpoint temp.	**At chiller**	**Yes**	**40.1 F**	**40.1 F**	**Yes**
GPM	**At chiller**	**Yes**	**517**	**517**	**Yes**

Chillers Summary

- **CHILLERS SUMMARY:**
- **CT-1E:**
- During initial start-up chiller had a small leak at service valve. This was corrected and unit is missing pressure differential switches and unit was put online.
- **CT-2E:**
- This chiller had an AFD with a leak and a new drive was installed and unit is operating at this time.

Fan Unit Documentation Checks

CHECK	FCU-101E	FCU-102E	FCU-103E	FCU-104E	FCU-105E	FCU-106E	FCU-107E	FCU-108E
Equipment manufacturer's submittals, inc. performance data	√	√	√	√	√	√	√	√
Installation and startup manual	√	√	√	√	√	√	√	√
Startup documentation	√	√	√	√	√	√	√	√
Test and Balance report	√	√	√	√	√	√	√	√
Sequences and control strategies	√	√	√	√	√	√	√	√
O&M manuals	√	√	√	√	√	√	√	√

CHECK	FCU-109E	FCU-201E	FCU-202E	FCU-203E	FCU-204E	FCU-301E	FCU-302E	FCU-303E
Equipment manufacturer's submittals, inc. performance data	√	√	√	√	√	√	√	√
Installation and startup manual	√	√	√	√	√	√	√	√
Startup documentation	√	√	√	√	√	√	√	√
Test and Balance report	√	√	√	√	√	√	√	√
Sequences and control strategies	√	√	√	√	√	√	√	√
O&M manuals	√	√	√	√	√	√	√	√

Fan Coil Unit Equipment Data Checks

Criteria for Acceptance: In accordance with submittals as approved by *Engineering*.

DESCRIPTION	*FCU-101E*		
	As specified	*As submitted*	*As installed*
Manufacturer **MCQUAY**	YES	YES	YES
Model # **D-70**	YES	YES	YES
Serial # **FBOU306000673**	N/A	N/A	YES
Hot water unit	YES	YES	YES
Max water temp EWT 180 F	YES	YES	YES
LWT water 150 F	YES	YES	YES
Control type MDF/BMS	YES	YES	YES
Motor, volts 230v	YES	YES	YES
Motor, hp .50	YES	YES	YES
Manufacturer's Capacity Rating,gpm @ ARI standard conditions (catalog rating)	YES	YES	YES
Manufacturer's Efficiency Rating, w @ ARI standard conditions (catalog rating)	YES	YES	YES

Fan Coil Unit Commissioning Report

FAN COIL UNITS
Equipment Tags: FCU-101E-109E, 201E-204E, 301E-303E

This Commissioning report addresses Fan Coil system performance verifying that the fan coil units where installed, connected and functionally tested or modified under the scope of this contract. This will include but not limited to review and testing of all peripheral items such as valves, sensors, safeties. Functionally test under load or simulated load conditions to verify operation and correct interface with the Building Management System as required. Completed Observation Report Form for all deficiencies are enclosed.

PARTICIPANTS

Mortenson/Klinger Co, KJWW Engineering, FEH Associates, Hagan Co., and Tessier's Inc.

Approval: *This completed Commissioning report has been reviewed.*

_____ _____

Commissioning Agent Date

What should be Budgeted for Building Commissioning?

- The following are the rules when helping a client budget for building commissioning.
  - $.40 to $1.50 per square foot depending on the complexity, size and location of the building.
  - 1.0 to 2.0 % of the total construction cost.

Cost Savings for Building Commissioning

- 8% - 20% reduction in operating costs for a building that is commissioned.

- 1.5 – 3.5 year simple payback on commissioning.
  Based on:
  - fewer change orders,
  - lower energy usage, and
  - reduced operational problems.

What Does Building Commissioning Involve?

- Verifying and documenting building systems' performance through all phases of a project from concept to occupancy.

- Testing HVAC systems' performance to ensure that they meet the needs of the building throughout the full range of operating parameters that may be encountered.

What Does the Energy Code Require?

- Systems Commissioning and Commissioning Requirements. (Section 1416.4 & Section 1513.7)
- Preliminary Commissioning Report. A preliminary report of test procedures and results. (1416.4.2.2.1)
- Final Commissioning Report. A complete report of test procedures and results shall be prepared and filed with the owner. (1416.4.2.2.2)
- Functional testing of the HVAC equipment and controls. (Section 1416.4)

What Does LEED Require for Building Commissioning?

LEED

Leadership in Energy and Environmental Design

- LEED requires the use of an independent building commissioning agent.
- LEED requires Fundamental Building Systems Commissioning (required for all LEED certified projects).

Resources

- Building Commissioning Association